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MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY

COMMUNICATED BY E. B. TITCHENER and H. P. WELD

XXIII. ON INTENSIVE AND QUALITATIVE JUDGMENTS OF LIGHT SENSATIONS

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By E. J. GATES

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Since Hering showed the qualitative character of the black-white series, there has been much discussion regarding the intensive attribute of sensations of light. We sought, in the present study, to find out whether an observer is able to compare two such sensations both qualitatively and quantitatively; whether, that is, it is possible to determine both an intensive and a qualitative limen with the same light stimuli; and, if so, whether the two limens coincide.

*Apparatus.* We used the Whipple apparatus for discrimination of brightness.<sup>1</sup> The lamp was a 10 watt, 110 volt, frosted Mazda; observations were taken only during hours when the university current is not subject to rapid fluctuation. The reflectors were covered evenly with a blue paper (Milton Bradley blue tint no. 2). The observer sat with his head in a head-rest, and with his eyes distant 50 cm. from the windows of the apparatus. Exposure was made by means of a shutter; the regular exposure was 5 sec.; but if judgment was passed within that limit of time, the shutter was immediately closed. The work was done in a dark room, with adaptation to dark.

*Method.* The method of limits, as set forth in Titchener's Manual, was followed for the determination of a lower *DL*. The normal stimulus was given by the setting of the pointer at 0° of the scale (high but not maximal illumination); the unit of change for the stimulus of comparison was 2° of the scale. The experiment was so planned that the ascending and descending series, the right and left positions of the normal stimulus, and the instructions for intensive and qualitative judgments, were evenly distributed. In all, 64 series were taken from each observer. Preliminary practice was given, under definite instruction, in order that a standard of judgment might be attained.

*Observers and Instruction.* The observers were Dr. E. G. Boring (B) and Mr. G. J. Rich (R). The former was highly practised, and had a full theoretical knowledge of the question at issue; the latter was relatively unpractised, and knew no more of the problem than he had learned in a course of lectures on systematic psychology. At the beginning of every series, the observers were told that it would

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<sup>1</sup> G. M. Whipple, Manual of Mental and Physical Tests, 1910, 163; i., 1914, 197.

be an ascending or a descending series, and were instructed to judge in terms of intensity (by 'greater,' 'equal,' 'less') or in terms of quality (by 'lighter,' 'same,' 'darker'). No introspective reports were required during the experiment; but at its close the observers were asked to distinguish, as accurately as they could, between the intensive and qualitative judgments and attitudes.

*Results.* The numerical results were as follows; the units are degrees upon the scale of the apparatus:

	Observer B	Observer R
Qualitative <i>DL</i> .....	25.1±4.1	27.6±2.7
Intensive <i>DL</i> .....	22.2±4.6	24.6±3.1
Qual. <i>DL</i> ascending.....	23.5±3.8	26.4±2.3
Qual. <i>DL</i> descending.....	28.7±4.2	28.9±2.8
Int. <i>DL</i> ascending.....	19.4±4.0	24.1±3.9
Int. <i>DL</i> descending.....	25.1±3.2	25.1±2.3
Qual. space error.....	-3.4	-1.6
Int. space error.....	-3.1	-1.6

The probabilities that the difference between the qualitative and the intensive *DL* (2.9, 3.0) is significant are, in the case of B, nearly 100:1 and, in the case of R, enormously greater.

*Discussion.* It is clear that the two observers have approximately the same *DL*; and it is clear, from the trend of the figures, that they adopted similar attitudes to the stimuli. The reports appear to show (1) that the instruction for quality brought out ordinarily pure qualitative judgments, but (2) that the instruction for intensity brought out judgments of insistence or *Eindringlichkeit* and not of intensity proper. Observer B writes:

"In judging 'intensity' I tried to give myself up to the quantitative aspect of the experience, to take it with regard to the 'total force of the impression.' The judgment was generally in terms of relevant kinaesthesia; the one which came nearer to 'knocking me down,' as it were, was taken as the more intense. Quality was judged as 'degree of blackness.' I do not know whether I could have done my series in terms of white, *i. e.*, taken the ascending series as meaning 'more white' and the descending as 'less white,' but it does not seem to me now that I could. The judgment 'lighter' was particularly hard to give, and in those descending series where I did give it, I actually shifted the basis of judgment. . . . I was early aware that the qualitative limen seemed to be greater than the intensive, and this fact may have influenced my judgments. I was generally aware of both changes in a given series; and in the descending qualitative series would not expect a change until the intensive change had appeared; contrariwise in the ascending intensive series. I was less certain of the qualitative judgments than of the intensive. This was due, I believe, to the fact that the equality of the intensive series meant more nearly a total identity than did the 'same' of the qualitative series. It is always easier to judge of identity of two impressions in respect to all their attributes (*cf.* color-mixing) than

to judge of identity of a single pair of attributes when the others differ."

B, then, judged 'intensity' by total impression or insistence, and naturally found these judgments easier than the qualitative.<sup>2</sup> R writes, less analytically:

"I had considerable difficulty in getting criteria of difference between quality and intensity. I presently came to take intensity, not as intensity of visual sensation, but as intensity of this whitish sensation; however, it was always more or less of a qualitative thing. As the variable slit was changed from sameness or equality, the first difference I noticed was what I reported as a difference in intensity. It came in very gradually, but was not difficult to judge. A little further along there was another change, and this I reported as difference in quality; towards the end of the experiment I was surer of it."

In the light of B's report, it seems permissible to say that R, too, judged 'intensity' by total impression or insistence.

Referring now to the numerical results, we see that the intensive limens are in fact significantly smaller than the qualitative limens which correspond with them; though the subjective assurance of the observers is not reflected objectively in the values of the *MV*. It is noteworthy, however, that the two series which are mentioned by B as involving the dual criterion (the descending qualitative and the ascending intensive) give the extreme liminal values: the descending qualitative goes lower than its pair towards black, and the ascending intensive goes higher towards white.

*Remarks on Method.* We made various attempts (gelatines, tissues) to eliminate the yellowish quality of the stimuli, and finally had recourse to the blue paper spread on the reflectors. In the preliminary series this paper was judged to be effective. In the experiment itself, R did not notice color; but B writes: "The stimuli were noticeably yellow and seemed more so at some times than at others. I constantly and consciously abstracted from the color, which was bothersome, however, only in the intensity series." If the experiment is repeated, the yellow should be more adequately compensated.

The exposure-time of 5 sec. is probably too long. The observers knew their method, and realized that they were to give immediate judgments. In cases of difficulty, however, they utilized the full 5 sec. B writes: "I was bothered at times by the fear that I was considering an extensive difference in the qualitative series; for in cases of long exposure the 'blackness' seemed occasionally to appear in patches. I am not sure of this, however." Care was taken, of course, that there should be no interference by after-images; but an exposure-time of 3 sec. would probably have simplified the experiment. We chose the longer time with the idea that the judgments would thereby gain a surer and more definite basis.

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<sup>2</sup> Cf. the ease of judgment reported by L. G. Meads, this JOURNAL, xxvi., 1915, 151. As B observed in this study, and may therefore be thought to have been influenced by suggestion in the present work, it is well to state that our series were completed before Meads' were begun.

*Conclusion.* We conclude, so far as this study goes, that 'intensive' judgments of light sensations are likely to be founded upon insistence or 'power to catch the attention' rather than upon intensity itself. We think it possible that some of the extant determinations of the *DL* for 'brightness' are measures of this insistence rather than of intensity or quality. Whether it is possible by more rigorous instruction, inducing a conscious abstraction from other attributes, to secure a true intensive *DL* of light sensation remains an open question.